IN THE SPECIFICATION

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[0010] In accordance with one embodiment of the invention, acoustically damped payload fairing composite 8 includes outer face sheet 10, inner face sheet 12, lightweight core 14, outer visco elastic adhesive layer 16, and inner visco elastic adhesive layer 18. Outer face sheet 10 forms the exterior of the payload fairing and is exposed to the atmosphere; inner face sheet 12 forms the interior of the payload fairing. Outer face sheet 10 and inner face sheet 12 are bonded to lightweight core 14 with outer visco elastic adhesive layer 16 and inner visco elastic adhesive layer 18, respectively. Outer face sheet 10 and inner face sheet 12 are preferably constructed from a rigid resin impregnated fiber, and more preferably from a graphite epoxy, such as ~~Stesalit PN900~~ STESALIT PN900 graphite epoxy, ~~Cycom 5210LO~~ CYCOM 5210LO graphite epoxy, or the like. Both face sheets are thin, preferably between about 1.6 millimeters and 12.7 millimeters (about 0.0625 inches and 0.5 inches) thick in cross section, and most preferably both face sheets are the same thickness and are about 3 millimeters (about 0.125 inches) thick in cross section. In accordance with one embodiment of the invention the face sheets are made of a plurality of layers or plies of fiber mat. The number of plies in the outer and inner face sheets, as well as the orientation and direction of the plies in both face sheets, may be varied in known manner in order to meet requirements for strength, stiffness, or the like.

[0011] The material bonding the face sheets to the lightweight core, in the preferred embodiment illustrated above, is described as visco elastic materials. Outer visco elastic adhesive layer 16 and inner visco elastic adhesive layer 18 may be, for example, ~~V112 from the 3M Corporation~~ 3M V112 adhesive, or the like. Both outer visco elastic adhesive layer 16 and inner visco elastic adhesive layer 18 may be between about 0.8 millimeters and 3 millimeters (about 0.03 inches and 0.125 inches) thick in cross section, though it is preferable that both visco elastic adhesive layers are the same cross-sectional thickness and are about 3 millimeters (about 0.125 inches) thick in cross-section. Other bonding materials may also be employed in

the acoustic composite construction in accordance with the invention as long as those bonding materials allow for relative movement between the outer and inner face sheets.

[0012] Lightweight core 14 is constructed from a low-density material, preferably low density foam that is less than about 48 kilograms per cubic meter (about 3 pounds per cubic foot) such as ~~HT50 from the Divinylcell Corporation~~ DIVINYLCELL HT50 foam, or the like. In accordance with one embodiment of the invention the cross-sectional thickness of lightweight core 14 is chosen such that outer face sheet 10 and inner face sheet 12 are placed a distance apart (in cross section) that is equal to one quarter the wavelength of the dominant acoustic frequency to which the acoustically damped payload fairing composite will be exposed. For example, if the dominant acoustic frequency to which the acoustically damped payload fairing composite 8 will be exposed is a frequency of 500 hertz, the lightweight core 14 would be about 15-16 cm (about 6 inches) in thickness. Placing the two face sheets this distance apart creates an impedance mismatch between the face sheets, damping the dominant frequency to which the acoustically damped payload fairing will be exposed. When coupled with the broadband acoustic reduction from the visco elastic construction, the payload fairing now provides good overall acoustic reduction across the entire low frequency region.

[0014] Traditional payload fairing composites use a high density foam core that is less than 25.4 millimeters (one inch) thick, making lightweight core 14, as well as acoustically damped payload fairing composite 8, much thicker than a typical payload fairing composite. However, using a low density material such as ~~HT50 from the Divinylcell Corporation~~ DIVINYLCELL HT50 foam instead of the high density foam core of the prior art (typically greater than 112 kg/m3 (7 lbs/ft3) and often as high as 193 kg/m3 (12 lbs/ft3)), makes the acoustically damped payload fairing composite weigh about the same as a traditional payload faring composite. Also, despite the greater thickness of acoustically damped payload fairing composite 8 compared to traditional payload fairing composites, eliminating the need for acoustic blankets or an add-on damping system inside the payload cargo area maximizes the payload cargo volume for a given outside volume. Even though the low density material used in lightweight core 14, by itself, is not as strong as the prior art higher density foam, the wider

spacing between the face sheets in the acoustically damped payload fairing composite in accordance with the invention adds significant stiffness to the structure and makes the inventive composite construction strong enough to handle the particular loads to which a payload fairing is exposed. High collapse pressure loads and shear crimping that are the primary means of structural failure for a payload fairing or the forward portion of a rocket or missile construction. The secondary line loads, namely a combination of bending, shear, and axial loads caused by atmospheric loads and friction, are low in the forward portion of a rocket or missile in comparison to the rest of the launch vehicle are. Therefore, the low density foam core which has proportionally lower strength can be used in the forward portion of a rocket or missile due to the lower line-loads while the increased thickness of the composite construction acts to provide higher strength and stiffness to the forward portion of a launch vehicle to satisfy its primary loading scenario.